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(54) Knee prosthesis.

(57) An implantable knee prosthesis has a femoral member 20 connected to a tibial member 22 via a hinge pin 24, 26, 28 that fits into a pivot hole 36 of involute profile to permit twisting of the femur relative to the tibia. A bearing pad 30 is provided for providing a reaction to part of the weight of the patient that is transmitted through condylar surfaces 32 of the femoral member 20. The member 30 has dished recesses 47, 48 on which the condylar surfaces 32 ride up when the knee is twisted so that there is an untwisting action when weight is applied to the joint.

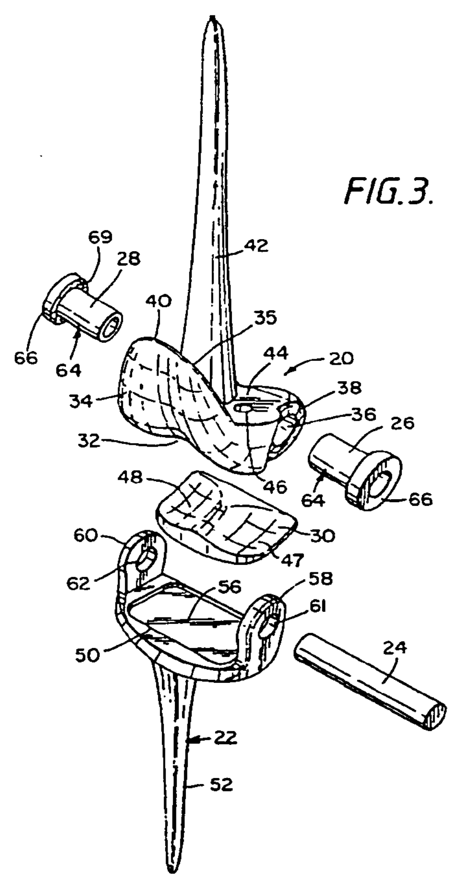

FIG.3.

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KNEE PROSTHESIS

The present invention relates to a knee prosthesis for implanting into a leg.

Knee prostheses in which a femoral member and a tibial member are hinged together are known. One such prosthesis is the so-called Stanmore hinged knee (see Lettin A. W. F., J. Bone Joint Surg, 1978, 60-b, 327-332. Another such prosthesis is the Attenborough knee (see Attenborough C. G., J. Bone Joint Surge, 1978, 60-b, 320-6). Although many patients have been treated successfully with these knees, further surgery has been required in a number of patients because the joints have loosened or become broken (see R. J. Grimer, J. Bone Joint Surg 1984, 66-b, 55 and C. J. Kershaw, J. Bone Joint Surg 1988, 70-b, 89).

The present invention provides a hinged knee replacement with provision for limited rotation at the knee so that twisting forces are less likely to be transmitted to the cemented joints between the prosthesis and the tibia and femur.

The invention provides a knee prosthesis comprising a femoral member connected to a tibial member by a hinge that permits twisting of the knee.

For provision of a returning or centralising centralising torque the prosthesis preferably includes means that forces the femoral member and the tibial member apart upon twisting of the knee so that weight applied through the knee has an untwisting action. In order to minimize wear at the hinge axle the tibial member has a support for condylar surfaces of the femoral member to produce a reaction to at least part and preferably to a major part of the weight on the femoral member. In a further feature, the prosthesis has an extended position defined by abutment of an anterior portion of the condylar surfaces with a support. If the support is a member of low-friction plastics material that is carried on and fits into the tibial member, metal to metal contact at the extended position of the knee is avoided.

In order to permit twisting of the knee, a hinge axle having a cylindrical outer surface fits into a pivot hole of the femoral member that has enlarged ends and is internally shaped so as to roll on the axle as it twists . The femoral member is positioned transversely of the knee by medial and lateral ball formations that fit between corresponding socket formations that are non-twistable relative to the tibial member . The axle is defined by a pin which is preferably metallic and by a pair of bushes that are preferably of plastics and fit onto the axle from opposite ends with end flanges of the bushes fitting between the femoral and tibial members. The socket surfaces are then formed on inner faces of the flanges.

The invention will now be further described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a Stanmore knee in a partly flexed position;

Figure 2 is a view of a knee prosthesis according to the invention in a flexed position;

Figure 3 is a perspective exploded view of the knee prosthesis of Figure 2;

Figure 4 is a front view of the prosthesis when unflexed: and

Figure 5 is a view of the prosthesis in transverse section.

In the drawings, Figure 1 shows a Stanmore knee which has been implanted into over 10,000 patients since 1968. Further surgery in a minority of patients has been required because of loosening of fixation, fracture of one or other of the intramedullary stems 10, 11 and other causes. There are a number of other features of this knee which could be improved. The patella flange 12 is narrow and not very anatomic in profile and shape. This has resulted in subluxation and dislocation of the patella with consequential retropatella pain and discomfort. The hinge axis 13 is more anterior than the anatomic knee hinge position, resulting in a reduced lever arm of the patella and consequential extension lag and reduced quadriceps efficiency particularly when rising from a chair or when ascending stairs. The hinge is relatively narrow and high moments acting on it result in excessive wear of plastics axle bushes fitted into the knee which results in varus valgus instability. Particles which have become detached from the prosthesis as a result of wear have nowhere to escape and accelerate wear of the hinge surfaces. The hyperextension stop that defines the unflexed position of the knee occurs on abutment of anterior portions of the femoral and tibial components 14, 15 relatively compact areas, with direct metal to metal contact, further aggravating the debris from wear of the metal. The torsional rigidity of the Stanmore knee can not only cause loosening of the implant but in two cases known to the applicants has caused torsional fractures of the femur. However, the Stanmore knee is simple to manufacture and can be fitted to a patient by a relatively simple and quick surgical procedure which has accounted for its popularity notwithstanding the problems mentioned above.

An object of the invention is to provide a knee prosthesis for implantation into patients that is not significantly more complicated than the Stanmore knee and is surgically simple to fit but which does

not suffer from the problems of that knee.

In Figures 2 to 5, a knee prosthesis comprises a femoral member 20 and a tibial member 22 which are each cast in a hard physiologically acceptable metal, for example cobalt chromium molybdenum alloy. The members 20, 22 are hingedly connected by a two-part axle consisting of an inner metallic axle pin 24 and a pair of axle bushes of plastics material 26, 28 that fit onto the axle pin 24. A tibial bearing member 30 of low-friction plastics material, for example ultra high molecular weight polyethylene, fits between the femoral and tibial members 20, 22.

The femoral member 20 has anatomically shaped and profiled condylar surfaces 32 leading to a broad patella flange 34 whose antero-proximal aspect 35 is shaped according to whether the knee is for the left or the right leg and which minimizes interference with the various blood vessels penetrating the bony cortex of the femur in the region of the patella. A transverse pivot hole 36 is located in or close to an anatomic position at the effective centre of rotation of the condylar surfaces 32, thus maintaining the natural lever arm of the patella and giving good quadriceps efficiency. The member 20 has convex spherical medial and lateral surfaces 38, 40 which locate and mate with corresponding concave seating surfaces 68, 69 of the bushes 26, 28 so that the femoral member rotates in and is located along a transverse direction by a ball joint. A femoral inter-medullary stem tapered with four flats is set at a genu-vagum angle of 7° and arises from a femoral plateau 44 formed with tightening holes 46 that also act to reinforce the cement mantle and improve the torsional fixing.

The tibial member 22 has a tibial tray 50 from the lower face of which a tibial intermedullary stem 52 depends at an angle of 3° of valgus. Because the stems 42, 52 are angled and the tray 50 is shaped to confirm to the top of the tibia , each component of the knee is left- or righthanded. A pair of anti-rotation pylons 54 spaced from the stem 52 depend from the tray 50 and are located so as to correspond to regions of greatest bone density. A recess 56 is formed in a proximal region of the tibial tray 50 and the tibial bearing member 30 is a snap fit into the recess 56. Medial and lateral lugs 58, 60 upstanding from the tray 50 are formed with apertures 61, 62 to receive the axle which is retained in position by a circlip (not shown). As is apparent from Figure 5, the tibial tray 50 is relatively large and when implanted extends over substantially the whole of the head of the tibia.

As previously stated, the axle is in two parts with the bushes 26, 28 that define the outer portion fitting loosely from opposite ends into the pivot hole 36 and abutting midway along the pivot hole. The concave socket surfaces 68, 69 locate on and slide freely over the medial and lateral surfaces 38, 40 of the femoral member 20. The member 20 carrying the bushes 22 fits closely between the medial and lateral lugs 58, 60 of the tibial member 22, after which the axle pin can be passed through the apertures 61, 62 and the bushes 26, 28 and held in place by circlips to complete assembly of the joint. The bushes 26, 28 are twice as long as the corresponding bushes in the Stanmore hinge, which is expected to reduce the peak lateral contact stresses by a factor of 8.

In the Stanmore hinge the whole of the patient's weight is taken on the hinge bushes, whereas in the present knee a major proportion of the patient's weight is transmitted through the condylar surfaces 32 to the tibia. For this purpose, the tibial bearing member 30 is formed with dished bearing surfaces 47, 48 conforming to the curvature of the condylar surfaces 32 which allow for articulation of the members 20, 22 when the prosthesis is flexed and which provide support when the prosthesis is unflexed. In the unflexed position, an anterior portion of the condylar surfaces 32 abuts and anterior portion of the bearing member 30 to provide a hyperextension stop without metal to metal contact. Thus the condylar surfaces 32 slide over posterior regions of the member 30 when the knee is flexed and return when the knee is unflexed until the anterior portions of the condylar surfaces 30 and the member 32 abut to define the hyperextended or unflexed position.

The involute or reverse barrel shape of the pivot hole 36 permits torsional laxity of the hinge joint of up to 8°, the joint being controlled by the ball surfaces 38, 40 that fit into the socket surfaces 68, 69. It is expected that the loads on the bushes 26, 28 will be relatively light, and consequently that there will be few wear problems. The divergent or barrel form of the pivot hole 36 provides a route for egress of any particles that become detached as a result of wear, thus reducing acceleration of wear through retention of particles between the hinge surfaces.

The prosthesis described above provides controlled flexion and extension together with a high degree of medial-lateral stability for varus valgus movements. There is good conformity of the bearing surfaces which gives good kinematic location, and the relatively low contact stresses expected should give reduced wear and improved joint life. (It will be noted that the various bearing surfaces are spherical or involute which avoids high point contact stresses). The torsional articulation between the femoral member 20 and the bushes 26, 28 of the axle can allow internal-external rotation of typically up to about 8°. On twisting of the femur relative to the tibia, the condylar surfaces 32 ride up on the dished surfaces 47, 48 of the bearing

member 30 and when the patient's weight is applied to the knee joint the axial load thereon provides a returning or centralizing torque which is similar to the screw-home axis of the knee described by some anatomists.

Claims

1. A knee prosthesis comprising a femoral member connected to a tibial member by a hinge that permits circumduction of the knee and prevents relative translational movement of the femoral and tibial members in a medial-lateral direction, the tibial member having a support for providing a reaction to at least part of a load which in use is transmitted through condylar surfaces of the femoral member and for preventing relative rotation of the tibial and femoral members in a medial-lateral plane, an axle connecting the femoral and tibial members fitting into a pivot hole of the femoral member whose ends are larger than its central region and which is generally of involute profile, the femoral member being positioned transversely of the knee by medial and lateral ball surfaces on one of the femoral and tibial members that fit between socket surfaces on the other of the femoral and tibial members.
2. A prosthesis according to claim 1, wherein means forces the femoral and the tibial members apart upon twisting of the knee so that weight applied through the knee has an untwisting action.
3. A prosthesis according to Claim 1 or 2, having an extended position defined by abutment of an anterior portion of the condylar surface with the support.
4. A prosthesis according to Claim 3 , wherein the support is a member of low-friction plastics material.
5. A prosthesis according to any preceding claim, wherein the axle is defined by a pin and a pair of bushes that fit onto the pin and have end flanges that fit between the femoral and tibial members, the socket surfaces being formed on inner faces of the flanges.
6. A prosthesis according to Claim 5, wherein the pin is of metal and the bushes are of a plastics material.
7. A knee prosthesis substantially as hereinbefore described with reference to and as illustrated in Figures 2 to 5 of the accompanying drawings.

FIG.1.

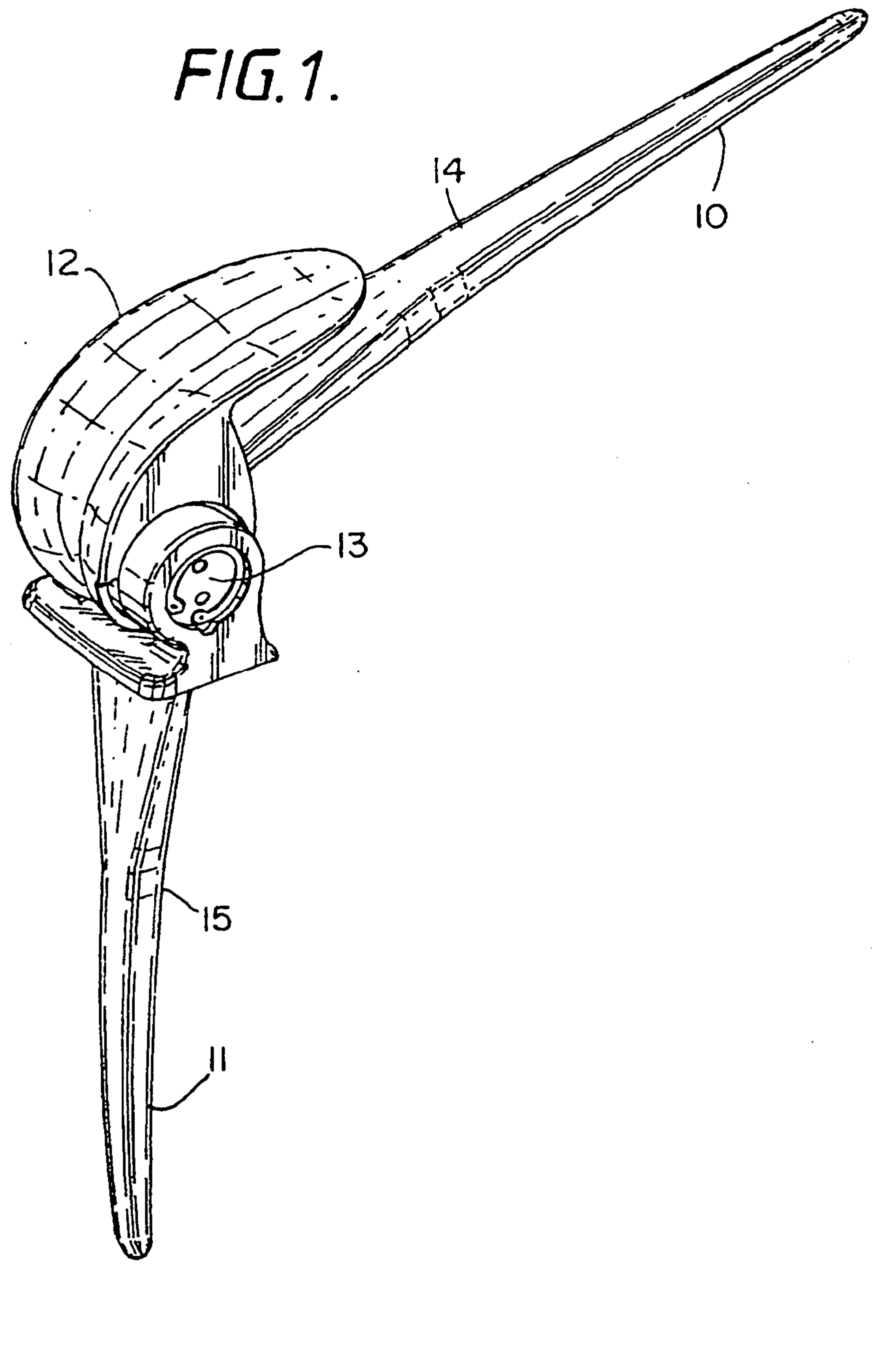

FIG. 2.

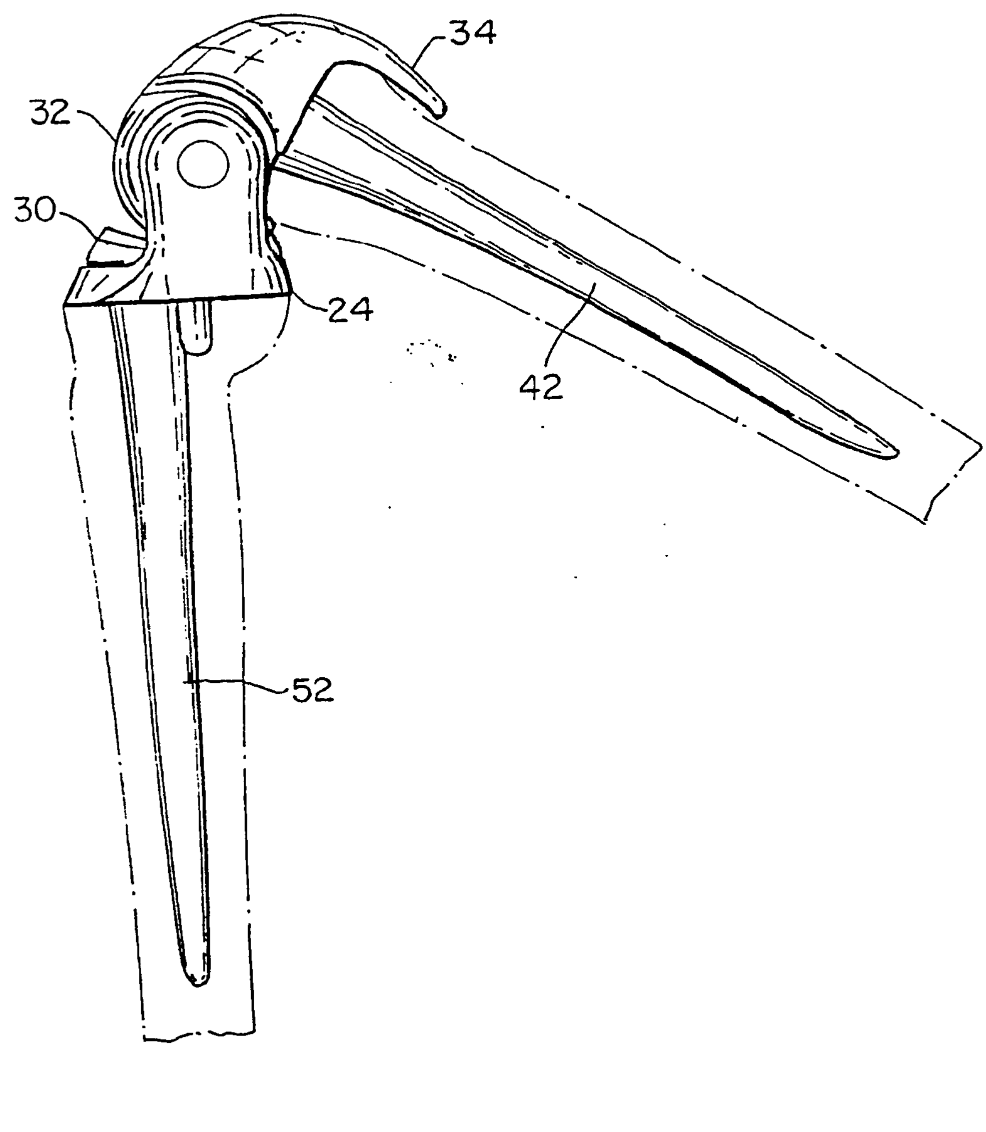

FIG. 3.

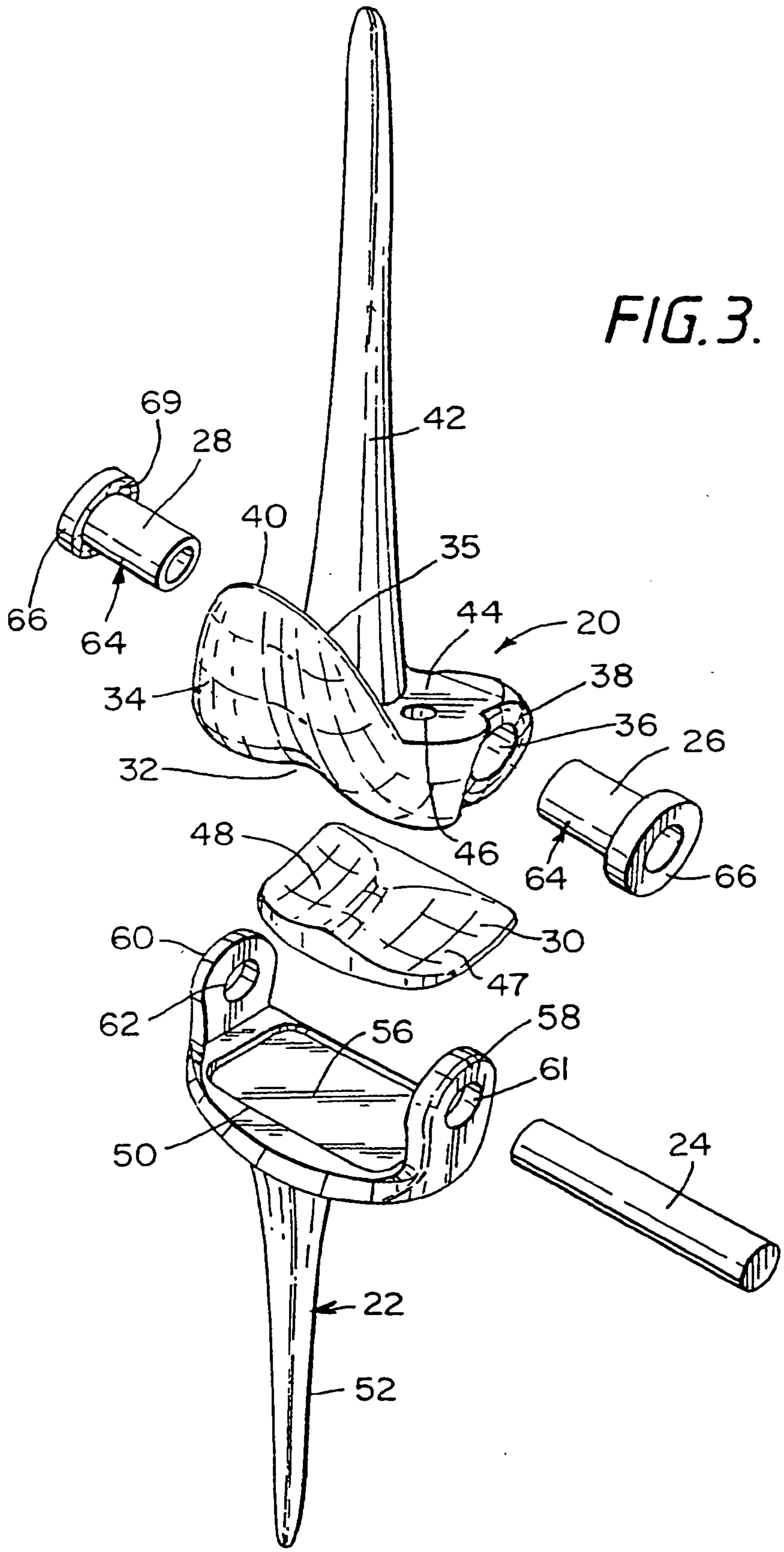
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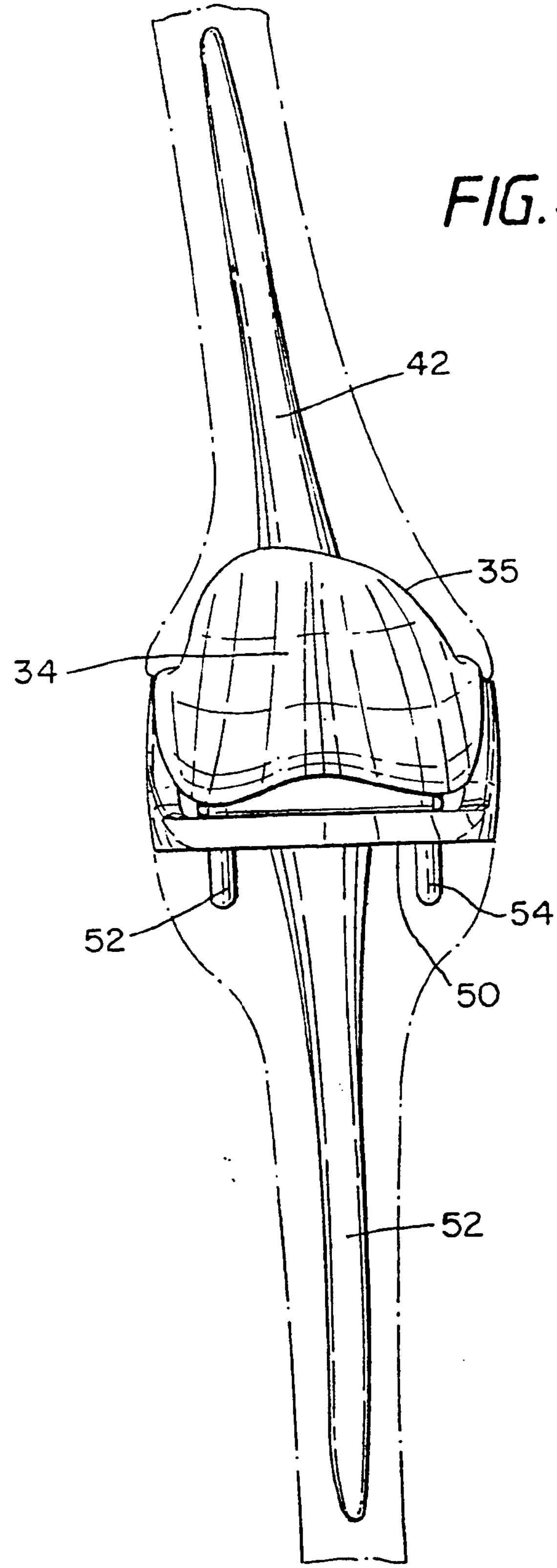
FIG.4.



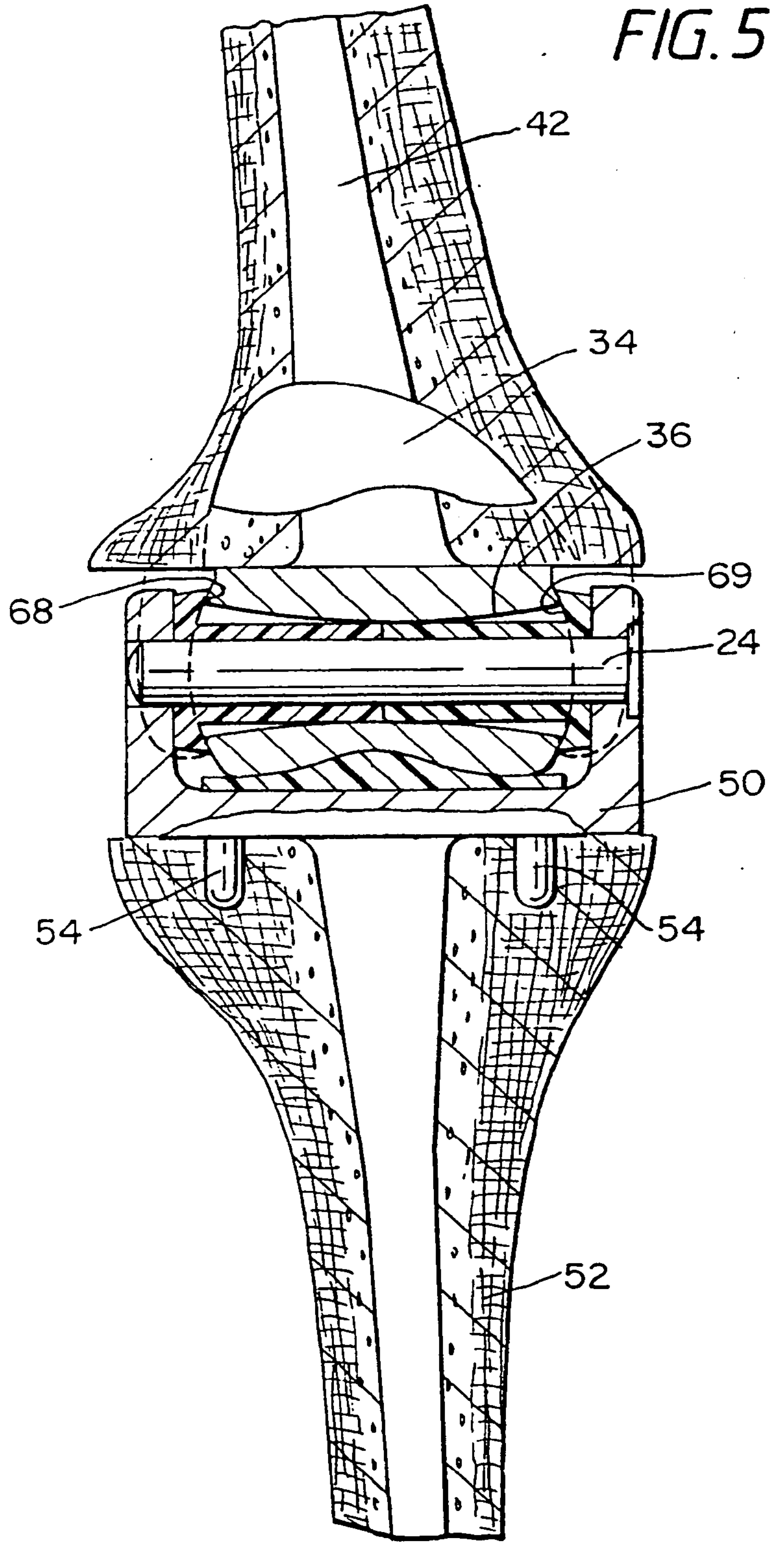


FIG. 5.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 31 0084

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-8 906 947 (FORTE) * Figures 14-20; page 14, line 28 - page 16, line 27 * - - -	1-7	A 61 F 2/38
A	DE-A-2 539 717 (FISCHER) * Pages 5,6,9,13 * - - -	1,2,3,7	
A	US-A-3 837 009 (WALKER) - - -		
A	FR-A-2 628 316 (LE BEGUEC) - - -		
A	GB-A-1 457 147 (THE UNIVERSITY OF MELBOURNE) - - -		
A	DE-A-2 122 390 (AESCULAP) - - -		
A	FR-A-2 445 137 (DEAUX) - - -		
A	FR-A-2 330 377 (SCHUTT & GRUNDEI) - - -		
A	FR-A-2 076 838 (BOUSQUET) - - -		
A	US-A-3 909 854 (MARTINEZ) - - - - -		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A 61 F

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	20 December 90	STEENBAKKER J.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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A: technological background
O: non-written disclosure
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